Two Specialised Ant species, *Crematogaster* (*australis* Mayr group) sp. and *Polyrhachis sokolova* Forel in Darwin Harbour Mangroves

MOGENS GISSEL NIELSEN

Institute of Biological Sciences, University of Aarhus, DK-8000 Aarhus C, Denmark

Abstract

Some ant species in northern Australia occur exclusively in mangrove communities. One is a species of *Crematogaster*, which nests in the hollowed branches of the Grey Mangrove *Avicennia marina*. The cavities are mostly made by weevil larvae, and the ants tend the coccid bug *Alecanopsis mirus* inside their nests. *Polyrhachis sokolova* is another mangrove specialist, and nests within intertidal mud. Their nests are inundated by up to 61% of high tides, and can be covered with more than 2 m of seawater. The entrances of the nests collapse when flooded and form a plug, which prevents water from penetrating the nest. A cast of the galleries showed that the nest extends up to 50 cm below the mud surface. Drowning experiments showed that the ants can survive immersion in seawater for up to 3.5 hours, but the colony needs to trap air in the nest to survive frequent flooding.

Introduction

Ants have an ability to inhabit most terrestrial ecosystems in the world, and in many environments they are the most important ecological group among animals (Hölldobler & Wilson 1990). Ants are nearly always associated with dry environments, but there are a few exceptions (Nielsen 1986; Yensen *et al.* 1980). One of these exceptions is mangrove communities, which are normally considered as marine ecosystems.

The tropical mangroves in northern Australia are highly productive, and very important breeding and foraging areas for many birds and marine organisms (Hanley 1992). Mangroves are also the breeding ground for several blood-sucking insects (mosquitos and midges), and they have therefore been the subject of many studies on the impact of these insects on humans (Hutchings & Saenger 1987). However little has been published about other mangrove-dwelling insects, and most information about the ant fauna derives from broader investigations and surveys (Ellway 1974; De Baar & Hockey 1987, 1993; De Baar 1994).

The mangroves of Darwin Harbour support at least 16 ant species, most of which are also found in other habitats (Clay & Andersen 1996). However a few species seem to be restricted to mangroves. The contrasting biologies of two of these species, *Crematogaster* (*australis* Mayr group) sp. and *Polyrhachis sokolova* Forel, are outlined here.

Crematogaster sp.

Like many other *Crematogaster* species throughout the world, this small (2 mm) species nests in cavities within branches (Hölldobler & Wilson 1990). They appear to be restricted to mangroves, and, more particularly to the Grey Mangrove *Avicennia marina*. The ants are not capable of excavating the cavities themselves, but are dependent on holes tunnelled by weevils (De Baar & Hockey 1993). Therefore the nest sites and the extension of the cavities are limited by the abundance of the beetles.

The number of nest-sites in each tree varies markedly. In one of the trees I searched in Darwin Harbour, at least three distinct colonies were identified, and each of them consisted of up to ten separate compartments. The volume of the different compartments in the nest ranged from less than one to several hundred millilitres, but the entrances to them were always less than 2 mm in diameter.

In each colony the functional queens with numerous eggs were located in one chamber, and larvae or pupae were found in most of the other chambers. The most conspicuous insects in many of the chambers were the large (up to 9 mm) pink coccids, *Alecanopsis mirus* Green, which often covered the whole surface of the cavity (Cover Plate). The coccids are strongly attached to the surface of the cavities, and only the first instar nymphs are mobile and capable of moving around in the nest. The attached coccids feed on the plant-sap and produce honeydew, which probably is the main source of energy for the ants.

I established artificial nest-sites, both by drilling holes in, and by attaching branches with drilled holes to, stems. Most of these artificial nests were occupied by ants within 10 days, and first instar coccids were found in three of the nine nests. How the coccids had dispersed is unknown, but given that they are incapable of walking, it is likely that they were transported by ants.

Polyrhachis sokolova

This large (7–8 mm long), black, spiny ant is commonly seen running around on the mud-flats and in trees. It is probably the most "marine" ant species recorded due to its nesting site among crabs and mudskippers. The nests are situated in the mud, and they are found from the drier Spurred Mangrove *Ceriops tagal* to the wet Stilt-rooted Mangrove *Rhizophora stylosa* zones, with nest elevations ranging from 7.22 to 5.99 m above lowest astronomical tide (LAT).

The official data for the tides in Darwin Harbour show that the nests at the highest elevation are inundated on 13 % of the high tides and at durations of up to 1.25 h, whereas the lowest situated nests are inundated on 61 % of the high tides and inundated up to 3.75 h, with up to more than 2 m of seawater above the nest.

How can they survive in these wet conditions? There are two possibilities: either the ants can tolerate immersion in seawater for long periods, or they trap air in the nests, so they can live a terrestrial life in the mud under the seawater. My drowning experiments have shown that the ants are reasonably tolerant to immersion, but after 3.5 h in 30° C seawater the mortality reached 50%. Therefore the colony cannot survive prolonged tidal floodings without having air trapped in the nest.

Excavations of a number of nests showed that they can extend more than 100 x 50 cm. Normally there are two nest-entrances, both elevated above the mud surface and close to the trunk of a tree. The galleries (Plate 1) are most abundant in the upper 20 cm of the mud, but can reach 45 cm depth. The numerous small chambers are situated around the very developed root systems which prevent the air filled chambers from collapsing during the high pressure at maximum tides. Most of the entrances were surrounded by a crater of particulate soil, which the ants have excavated from the nest.

PLATE 1 A polyurethane-foam cast of the gallery system of the mud nesting ant, *Polyrhachis sokolova*. The measuring tape indicates the mud-surface. (M. Nielsen)

When the tide reaches the nest-entrance the loose soil particles collapse and form a stopper, preventing the water from entering. When the tide recedes the ants open the entrances as soon as they are above the water level. The chamber walls are made of clay, which is very impermeable to water, and during excavation at high water level, it was found that all chambers contained air even when they were situated below the water level. During flooding, air can be squeezed out of the nest by treading on the submerged nest.

The ants forage in the trees and on the soil-surface, for a broad range of arthropods. The swollen gaster of some of the returning workers indicate that they also collect liquid food, and they have been observed feeding on bird excrement. At incoming tides the foraging workers often show a special swimming behaviour on the water surface in order to reach the nest-entrance before it is flooded. When the tide recedes the ants start foraging before the soil is dry, and use the same running or swimming behaviour to cross wet areas during their foraging on the mud surface.

Final remarks

These two ant species are examples of specialized insects adapted to live in mangroves. The vast expanses of mangroves in northern Australia, coupled with the extremely limited studies of their insect faunas, make it likely that many more interesting and specialized insects are to be discovered. Unfortunately, fieldwork in mangroves can be unpleasant because of the high temperatures and humidity, and the lack of a cooling breeze. The number of stinging insects can be formidable, and there is always the possibility of meeting saltwater crocodiles! Yet these inconveniences are soon forgotten when working in this fascinating habitat.

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